

CONSIDERATIONS ON PLANTS AND ECOSYSTEMS DIVERSITY AND CONSERVATION WITHIN FOUR LOCATIONS ALONG THE RIVER MUREȘ/MAROS

Gicu-Gabriel Arsene, Iulia-Natalia Dărăban, Violeta Turcuș, Ioan Don, Aurel Ardelean, Marian-Constantin Petrescu, Daciana Turcuș

Introduction

The valley of the River Mureș, and the river itself, represent a main ecological corridor in West-Romania. Especially in the plain areas of the Arad and Timiș counties, in a monotone agricultural landscape, riverine natural and semi-natural habitats are important not only for wildlife, but also as an element of human life quality and well-being. Setting the Lunca Mureșului Natural Park, downstream Arad city until the Romanian-Hungarian border, in 2003, constitutes a formal appreciation of these ecosystems value and a commitment assumed by Romanian authorities. Unfortunately, we have hitherto only descriptive studies concerning the flora and vegetation within this protected area (e.g. Ardelean 1995, 2006, Oprea 1976). There is an acute need of scientific ecological results in order to be used as decisional and pragmatic base in case-to-case nature management situations. Within the scope of the HURO project *Landscape-scale connections between the land use, habitat quality and ecosystem goods and services in the Mures/Maros valley (HURO/0901/205/2.2.2)*, we sampled four locations along the river Mureș and draw up a picture of plant and habitat diversity. We focused also on present-day (semi)natural ecosystems status, in search of a reconnaissance of ecosystem services, anthropic pressure degree and threats.

Material and Methods

The study was carried out in 2012 in four locations, along the Mureș river, in the Arad County: Păuliș (near the city Lipova), Vladimirescu (about 10 km up-river from city of Arad), Felnac, and Igrăș (see Fig. 1 at page 5); the last two ones are included in the Lunca Mureșului Natural Park. The altitude ranges from ca. 85-90 m a.s.l. (Igrăș) to ca. 120-125 m a.s.l. (Păuliș). Each sampled area is a 3 × 3 km quadrat having a high diversity of ecosystems on both river margins

Flora was studied on transects; the floristic inventory includes also species from coenological relevés. Species identification was done according to Săvulescu (1952-1976) and Ciocârlan (2009). The considered nomenclature is from Flora Europaea Database (<http://rbg-web2.rbge.org.uk/FE/fe.html>). In the floristic

conspectus, at each species, the location is mentioned, e.g. [P., V., F., I.] means the species was found at Păuliș (P.), Vladimirescu (V.), Felnac (F.) and Igrăș (I.).

In the study of vegetation, we made relevés on 2 × 2 m (herbaceous vegetation), 10 × 10 m (scrubs) and 20 × 20 m (forests). Percentage cover of each species was estimated. Observations on threats, naturalness degree were made also.

In both cases (flora and vegetation), we did not pay attention to cultivated fields, but analyzed field edges.

The typology of habitats was established starting from phytosociological data (Ardelean 2006, Drăgulescu 1995, Sanda *et al.* 2008), and then using *Habitats of Romania* (Donță *et al.* 2005), *EUR 27 Interpretation Manual of EU Habitats* and the Romanian guide to habitats interpretation (Gafta & Mountford, 2008).

Results

Floristic conspectus

Abutilon theophrasti Medik. [V., F., I.]; *Acer campestre* L. [V., F.]; *Acer negundo* L. [P., V., F., I.]; *Acer tataricum* L. [V., I.]; *Achillea millefolium* L. [P.]; *Achillea setacea* Waldst. & Kit. [P., V., F., I.]; *Adonis vernalis* L. [F.]; *Agrimonia eupatoria* L. [P., V., I.]; *Agrostis capillaris* L. [P., V., F.]; *Agrostis stolonifera* L. [P., V., F., I.]; *Ailanthus altissima* (Mill.) Swingle [V., I.]; *Ajuga genevensis* L. [P.]; *Alisma plantago-aquatica* (L.) [P., V., F., I.]; *Alliaria officinalis* [P., V., F.]; *Alliaria petiolata* (M.Bieb.) Cavara & Grande [P., F.]; *Allium scorodoprasum* L. [V., F.]; *Alopecurus pratensis* L. [P., V., F., I.]; *Althaea officinalis* L. [P., V., I.]; *Amaranthus crispus* (Lesp. et Thévenau.) N.Terracc. [I.]; *Amaranthus retroflexus* L. [P., V., F., I.]; *Ambrosia artemisiifolia* L. [P., V., F., I.]; *Amorpha fruticosa* L. [P., V., F., I.]; *Anagallis arvensis* L. [I.]; *Anemone ranunculoides* L. [V.]; *Anthemis arvensis* L. [I.]; *Anthoxanthum odoratum* L. [P., V.]; *Anthriscus sylvestris* (L.) Hoffm. [P., V.]; *Apera spica-venti* (L.) P.Beauv. [P., I.]; *Arctium lappa* L. [P., V., F., I.]; *Arctium tomentosum* Mill. [P.]; *Aristolochia clematitidis* L. [P., V., I.]; *Arrhenatherum elatius* (L.) P.Beauv. ex J.Presl & C.Presl [P., V., F., I.]; *Artemisia absinthium* L. [F.]; *Artemisia annua* L. [P., V.]; *Artemisia vulgaris* L. [P., V., I.]; *Asclepias syriaca* L. [P., V., I.]; *Asparagus officinalis* L. [V., F., I.]; *Asperula arvensis* L. [P.]; *Aster tripolium* L. (incl. subsp. *pannonicus*) [V., F.]; *Astragalus cicer* L. [F.]; *Astragalus glycyphyllos* L. [V., F.]; *Atriplex patula* L. [I.]; *Avena fatua* L. [I.]; *Bidens tripartita* L. [P., I.]; *Brachypodium pinnatum* (L.) P.Beauv. [F.]; *Brachypodium sylvaticum* (Huds.) P.Beauv. [P., V., F.]; *Bromus arvensis* L. [P., V., F., I.]; *Bromus commutatus* Schrad. [V., F.]; *Bromus hordeaceus* L. [P., V., F.]; *Bromus inermis* Leyss. [V., F., I.]; *Bromus tectorum* L. [P., V., F.]; *Butomus umbellatus* L. [P., I.]; *Calamagrostis arundinacea* (L.) Roth [P.]; *Calamagrostis epigejos* (L.) Roth [P., V., F., I.]; *Calamintha sylvatica* Bromf. (subsp. *sylvatica*) [V.]; *Calystegia sepium* (L.) R.Br. [P., V., I.]; *Capsella*

bursa-pastoris (L.) Medik. [P., V., F., I.]; *Cardaria draba* L. [P., I.]; *Carduus acanthoides* L. [P., V., F., I.]; *Carduus nutans* L. [P., V.]; *Caex brizoides* L. [P., V., F.]; *Carex distans* L. [P., V., F., I.]; *Carex divulsa* Stokes [V.]; *Carex hirta* L. [P., V., F.]; *Carex riparia* Curtis [P., F., I.]; *Carex sylvatica* Huds. [V.]; *Carex vulpina* L. [F.]; *Carlina vulgaris* L. [P.]; *Carpinus betulus* [P., V.]; *Carthamus lanatus* L. [V., I.]; *Celtis australis* L. [V., I.]; *Centaurea cyanus* L. [I.]; *Centaurea biebersteinii* DC. (subsp. *biebersteinii*) [P., F., I.]; *Centaurea pannonica* (Heuff.) Simonk. [P., V., F., I.]; *Centaurea solstitialis* L. [F.]; *Cerastium banaticum* (Rochel) Heuff. (subsp. *speciosum* (Boiss.) Jalas) [P.]; *Cerastium glomeratum* Thuill. [I.]; *Chaerophyllum temulentum* L. [V.]; *Chelidonium majus* L. [P., V., F.]; *Chenopodium album* L. [P., V., F., I.]; *Chenopodium ficifolium* Sm. [I.]; *Chenopodium hybridum* L. [F., I.]; *Chondrilla juncea* L. [P., V.]; *Cichorium intybus* L. [P., V., F., I.]; *Circaea lutetiana* L. [V.]; *Cirsium arvense* (L.) Scop. [P., V., F., I.]; *Cirsium oleraceum* (L.) Scop. [V., F.]; *Cirsium rivulare* (Jacq.) All. [V.]; *Cirsium vulgare* (Savi) Ten. [P., V., F.]; *Clematis vitalba* L. [P., V., F., I.]; *Conium maculatum* L. [V., F., I.]; *Consolida regalis* Gray [P., V., F., I.]; *Convallaria majalis* L. [V.]; *Convolvulus arvensis* L. [P., V., F., I.]; *Conyza canadensis* (L.) Cronquist [P., V., F., I.]; *Cornus mas* L. [V., I.]; *Cornus sanguinea* L. [P., V., F., I.]; *Coronilla varia* L. [F.]; *Corydalis cava* (L.) Schweigg. & Körte [V., F.]; *Crataegus monogyna* Jacq. [P., V., F., I.]; *Cruciata laevipes* Opiz [P.]; *Cucubalus baccifer* L. [P., F.]; *Cuscuta europaea* L. [I.]; *Cynodon dactylon* (L.) Pers. [P., V., F., I.]; *Dactylis glomerata* L. (incl. subsp. *aschersoniana* (Graebn.) Thell.) [P., V., F., I.]; *Danthonia decumbens* (L.) DC. [V.]; *Datura stramonium* L. [P., V., I.]; *Daucus carota* L. (subsp. *carota*) [P., V., I.]; *Descurainia sophia* (L.) Webb ex Prantl [V., I.]; *Dianthus armeria* L. [P., I.]; *Dichanthium ischaemum* (L.) Roberty [V., I.]; *Digitaria sanguinalis* (L.) Scop. [P., V., F., I.]; *Dipsacus laciniatus* L. [P., V., F., I.]; *Echinochloa crusgalli* (L.) P.Beauv. [P., V., F., I.]; *Echinocystis lobata* (Michx.) Torr. & A.Gray [P., V., F., I.]; *Echinops ritro* L. (subsp. *ruthenicus* (M.Bieb.) Nyman) [P., V.]; *Echinops sphaerocephalus* [F., I.]; *Echium vulgare* L. [P.]; *Elaeagnus angustifolia* L. [I.]; *Eleocharis palustris* (L.) Roem. & Schult. [P., V., F., I.]; *Elymus repens* (L.) Gould [P., V., F., I.]; *Epipactis helleborine* (L.) Crantz [V.]; *Epilobium hirsutum* L. [P., V.]; *Epilobium palustre* L. [P., V., F.]; *Equisetum arvense* L. [P., V., F., I.]; *Erodium cicutarium* (L.) L'Hér. [F., I.]; *Eragrostis minor* Host [P., V.]; *Erigeron annuus* (L.) Pers. [P., V., F., I.]; *Erophilla verna* (L.) Chevall. [P., V., F.]; *Eryngium campestre* L. [P., V., F., I.]; *Eryngium planum* L. [P., V.]; *Euonymus europaeus* L. [P., V., I.]; *Eupatorium cannabinum* L. [P.]; *Euphorbia amygdaloides* L. [P., V., F.]; *Euphorbia cyparissias* L. [P., V., F., I.]; *Falcaria vulgaris* Bernh. [P., V., F., I.]; *Fallopia convolvulus* (L.) A&A.Löve [P., V., F., I.]; *Festuca arundinacea* Schreb. [P.]; *Festuca gigantea* (L.) Vill. [P., I.]; *Festuca ovina* L. [F.]; *Festuca pratensis* Huds. [P., V., F.]; *Festuca pseudovina* Hack. ex Wiesb. [P., F.]; *Festuca rupicola* Heuff. [P., V., F.,

I.]; *Festuca valesiaca* Schleich. ex Gaudin [I.]; *Filipendula vulgaris* Moench [P., V., F.]; *Fragaria vesca* L. [I.]; *Frangula alnus* L. [V., F.]; *Fraxinus americana* L. [I.]; *Fraxinus angustifolia* [V., F., I.]; *Fraxinus excelsior* L. [P., V., F., I.]; *Gagea lutea* (L.) Ker Gawl. [V.]; *Galega officinalis* L. [V., F., I.]; *Galeopsis speciosa* Mill. [P., V.]; *Galeopsis tetrahit* L. [V.]; *Galinsoga parviflora* Cav. [P., F., I.]; *Galium album* Mill. [P., V.]; *Galium aparine* L. [P., V., F., I.]; *Galium mollugo* L. [P., V., I.]; *Galium palustre* L. [P.]; *Galium rubioides* L. [V.]; *Galium schultesii* Vest [P., V.]; *Galium verum* L. [P., V., F., I.]; *Geranium robertianum* L. [V., F.]; *Geum urbanum* L. [P., V., F., I.]; *Glechoma hederacea* L. [P., V., F., I.]; *Gleditsia triacanthos* L. [P., V., I.]; *Glyceria maxima* (Hartm.) Holmb. [V., F., I.]; *Glycyrrhiza echinata* L. [V., F., I.]; *Glycyrrhiza glabra* L. [P., F.]; *Gratiola officinalis* L. [P.]; *Gypsophila muralis* L. [F.]; *Helianthus tuberosus* L. [V., I.]; *Heliotropium europaeum* L. [I.]; *Hibiscus trionum* L. [P., V., I.]; *Hippophae rhamnoides* L. [cultivated, V.]; *Holcus lanatus* L. [P., V.]; *Hordeum hystrix* Roth [F.]; *Hordeum murinum* L. [V., F., I.]; *Humulus lupulus* L. [P., V., F., I.]; *Hypericum perforatum* L. [P., V., I.]; *Inula britannica* L. [P., V., I.]; *Inula salicina* L. [V., F.]; *Iris pseudacorus* L. [P., V., F., I.]; *Juglans nigra* L. [V.]; *Juglans regia* L. [P., V., F.]; *Juncus conglomeratus* L. [P., V.]; *Juncus gerardi* Loisel. [F.]; *Juncus inflexus* L. [P., V., I.]; *Kickxia spuria* (L.) Dumort. [F.]; *Knautia arvensis* (L.) Coult. [P., V.]; *Koeleria macrantha* (Ledeb.) Schult. [F.]; *Lactuca saligna* L. [P.]; *Lactuca serriola* L. [P., V., F., I.]; *Lamium amplexicaule* L. [I.]; *Lamium purpureum* L. [P., V., F., I.]; *Lapsana communis* L. [P., V., F.]; *Lathyrus pratensis* L. [V., F., I.]; *Lathyrus sylvestris* L. [P., V., F.]; *Lathyrus tuberosus* L. [P., F., I.]; *Lavatera thuringiaca* L. [P.]; *Lemna minor* L. [V., F., I.]; *Lemna trisulca* L. [P.]; *Leontodon autumnalis* L. [P., V.]; *Leonurus cardiaca* L. [V., I.]; *Lepidium perfoliatum* L. [V., I.]; *Ligustrum vulgare* L. [P., V., F., I.]; *Linaria angustissima* (Loisel.) Borbás [V., I.]; *Linaria genistifolia* (L.) Mill. [P., V.]; *Linaria vulgaris* Mill. [P., V., F., I.]; *Logfia arvensis* (L.) Holub [V.]; *Lolium perenne* L. [P., V., F., I.]; *Lotus angustissimus* L. [F.]; *Lotus corniculatus* L. [P., V., F., I.]; *Lycium barbarum* L. [P., I.]; *Lycopus europaeus* L. [P., V., F., I.]; *Lycopus exaltatus* L.f. [P., I.]; *Lysimachia nummularia* L. [P., V., I.]; *Lysimachia vulgaris* L. [P., V., F., I.]; *Lythrum hyssopifolia* L. [V.]; *Lythrum salicaria* L. [P., V., I.]; *Maclura pomifera* (Raf.) C.K.Schneid. [P., V.]; *Malva sylvestris* L. [V., I.]; *Malus sylvestris* L. [V.]; *Marrubium vulgare* L. [P.]; *Matricaria perforata* Mérat [V., F., I.]; *Medicago lupulina* L. [P., V.]; *Medicago minima* (L.) Bartal. [V., I.]; *Medicago sativa* L. [P., V., F., I.]; *Melilotus alba* Medik. [P.]; *Melilotus officinalis* (L.) Pall. [F., I.]; *Mentha aquatica* L. [P., F.]; *Mentha arvensis* L. [P.]; *Mentha longifolia* (L.) Huds. [P., V., F., I.]; *Mentha pulegium* L. [V., F., I.]; *Mercurialis perennis* L. [V.]; *Mycelis muralis* (L.) Dumort. [P.]; *Morus alba* L. [P., V., I.]; *Morus nigra* L. [V., F., I.]; *Myosotis scorpioides* L. [P., V., I.]; *Myriophyllum spicatum* L. [P., I.]; *Oenanthe aquatica* [P., V., I.]; *Oenothera biennis* L. [P., I.]; *Ononis arvensis* L. [V., F., I.];

Onopordum acanthium L. [P., V., I.]; *Ornithogalum umbellatum* L. [V., F.];
Oxalis acetosella L. [P., V.]; *Papaver rhoeas* L. [P., V., I.]; *Parthenocissus
inserta* [P., V.]; *Pastinaca sativa* L. [P., V., F., I.]; *Petrorhagia prolifera* (L.)
P.W.Ball & Heywood [P., V.]; *Peucedanum oreoselinum* (L.) Moench [P.];
Phalaris arundinacea [V., F.]; *Phragmites australis* (Cav.) Trin. ex Steud. [P.,
V., F., I.]; *Picris hieracioides* L. [P., V.]; *Plantago lanceolata* L. [P., V., F., I.];
Plantago major L. [P., V., F., I.]; *Plantago media* L. [P.]; *Poa angustifolia* L. [F.,
I.]; *Poa annua* L. [P., V., F., I.]; *Poa pratensis* L. [P., V., F., I.]; *Polycnemum
arvense* L. [I.]; *Polygonatum latifolium* (Jacq.) Desf. [V.]; *Polygonum amphibium*
L. [P., F., I.]; *Polygonum aviculare* L. [P., V., F., I.]; *Polygonum lapathifolium* L.
[P., V., I.]; *Polygonum persicaria* L. [P., V., F., I.]; *Populus alba* L. [P., V., F.,
I.]; *Populus nigra* L. [P., V., F., I.]; *Populus tremula* L. [P., V.]; *Populus x
hybrida* M.Bieb. [P., V., F., I.]; *Portulaca oleracea* L. [P., V., F., I.];
Potamogeton natans L. [P.]; *Potentilla anserina* L. [P., V., I.]; *Potentilla reptans*
L. [P., V., F., I.]; *Prunella vulgaris* L. [P., V.]; *Prunus cerasifera* Ehrh. [P., V.,
F., I.]; *Prunus spinosa* L. [P., V., F., I.]; *Pulmonaria officinalis* [P., F.]; *Pyrus
pyraster* Burgsd. [P., V., F., I.]; *Quercus robur* L. [P., V., F., I.]; *Ranunculus
acris* L. [I.]; *Ranunculus ficaria* L. [P., V., F., I.]; *Ranunculus repens* L. [P., V.,
I.]; *Ranunculus sardous* Crantz [P., V., I.]; *Ranunculus sceleratus* L. [F., I.];
Rhamnus catharticus L. [I.]; *Robinia pseudacacia* L. [P., V., F., I.]; *Rorippa
austriaca* (Crantz) Besser [I.]; *Rorippa kernerii* Menyh. [P., F.]; *Rosa canina* L.
[P., V., F., I.]; *Rosa gallica* L. [P., F.]; *Rubus caesius* L. [P., V., F., I.]; *Rubus
fruticosus* L. [P., V.]; *Rudbeckia laciniata* L. [P.]; *Rumex acetosa* L. [P., V., F.,
I.]; *Rumex conglomeratus* Murray [F.]; *Rumex crispus* L. [P., F., I.]; *Rumex
sanguineus* L. [P., V.]; *Sagittaria sagittifolia* L. [P., V.]; *Salix alba* L. [P., V., F.,
I.]; *Salix caprea* L. [P., V., F., I.]; *Salix cinerea* L. [V., F., I.]; *Salix fragilis* L.
[V., F., I.]; *Salix triandra* L. [F.]; *Salsola kali* L. subsp. *ruthenica* (Iljin) Soó [I.];
Salvia nemorosa L. [P., V., F., I.]; *Sambucus ebulus* L. [P., V., F., I.]; *Sambucus
nigra* L. [P., V., F., I.]; *Saponaria officinalis* L. [V., I.]; *Scabiosa ochroleuca* L.
[P., V., F., I.]; *Scilla bifolia* L. [V., F.]; *Scirpus lacustris* L. (subsp. *lacustris*) [V.,
F., I.]; *Scrophularia nodosa* L. [V.]; *Senecio jacobaea* L. [P., V., F.]; *Senecio
vernalis* Waldst. & Kit. [I.]; *Setaria pumila* (Poir.) Schult. [P., I.]; *Setaria
verticillata* (L.) P.Beauv. [V., I.]; *Setaria viridis* (L.) P.Beauv. [P., V., F., I.];
Silene latifolia Poir. subsp. *alba* (Mill.) Greuter & Burdet [P., V., I.]; *Solanum
dulcamara* L. [P., V.]; *Solanum nigrum* L. [P., V., I.]; *Solidago virgaurea* L. [P.];
Sonchus arvensis L. [V., F., I.]; *Sorghum halepense* (L.) Pers. [P., V., F., I.];
Sparganium erectum L. [P., F., I.]; *Stachys annua* (L.) L. [V., I.]; *Stachys
palustris* L. [P., F.]; *Stachys sylvatica* L. [P., V.]; *Staphylea pinnata* L. [V.];
Stellaria media (L.) Will. [P., V., F., I.]; *Stellaria nemorum* L. [P., V.];
Symphytum officinale L. [P., I.]; *Tamus communis* L. [V.]; *Tanacetum vulgare* L.
[P., V., F., I.]; *Taraxacum officinale* Weber [P., V., F., I.]; *Teucrium chamaedrys*
L. [V., F.]; *Thalictrum minus* L. [V., F.]; *Thlaspi arvense* L. [F., I.]; *Thlaspi*

perfoliatum L. [V.]; *Thymus glabrescens* Willd. [I.]; *Tilia cordata* Mill. [V.]; *Tilia platyphyllos* Scop. [P., V.]; *Torilis arvensis* (Huds.) Link [V.]; *Tragopogon pratensis* L. [P., I.]; *Tribulus terrestris* L. [V.]; *Trifolium arvense* L. [P., F., I.]; *Trifolium medium* L. [P., V., F.]; *Trifolium pratense* L. [P., V.]; *Trifolium repens* L. [V., F., I.]; *Typha angustifolia* L. [F., I.]; *Typha latifolia* L. [P., V., F., I.]; *Ulmus laevis* Pall. [V., F.]; *Ulmus minor* Mill. [V., F., I.]; *Urtica dioica* L. [P., V., F., I.]; *Verbascum phlomoides* L. [P., V.]; *Verbascum blattaria* L. [I.]; *Verbena officinalis* L. [P., V., F., I.]; *Viburnum lantana* [P., V.]; *Vicia cracca* L. [P., I.]; *Vicia grandiflora* Scop. [P., V., F., I.]; *Viola arvensis* Murray [P., V., F.]; *Viola odorata* L. [P., V., F., I.]; *Viola reichenbachiana* Jord. ex Boreau [P., V., F.]; *Viola tricolor* L. [F., I.]; *Vitis vinifera* L. subsp. *sylvestris* (C.C.Gmel.) Hegi [P., V., I.]; *Vulpia myuros* (L.) C.C.Gmel. [P., V.]; *Vincetoxicum hirsutinaria* Medik. [V.]; *Veronica chamaedris* L. [V.]; *Xanthium spinosum* L. [P., V., F., I.]; *Xanthium strumarium* L. (incl. subsp. *italicum* (Moretti) D.Löve) [P., V., F., I.].

List of invasive species (sensu Anastasiu et al., 2008)

Acer negundo, *Ailanthus officinalis*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, *Amorpha fruticosa*, *Asclepias syriaca*, *Conyza canadensis*, *Echinocystis lobata*, *Erigeron annuus*, *Fraxinus pennsylvanica*, *Galinsoga parviflora*, *Helianthus tuberosus*, *Morus alba*, *Parthenocissus inserta*, *Robinia pseudacacia*, *Rudbeckia laciniata*, *Sorghum halepense*, *Xanthium spinosum*, *Xanthium strumarium* (incl. subsp. *italicum*).

Main habitats summary description

91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis*, and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*) (= R4404 Ponto-danubian mixed forests with *Quercus robur*, *Fraxinus sp.*, *Ulmus sp.*, with *Festuca gigantea*)

These forests occur in all four locations, as well as along the River Mureş and other rivers in forest-steppe (Ardelean, 2006, Paşcovschi & Doniţă, 1967); they constitute the primary climax vegetation on non-flooded terrains. The canopy reaches the maximum height of 25-28 m and is composed by species as *Quercus robur*, *Fraxinus angustifolia*, *F. excelsior* (mainly, in variable proportions), *Ulmus laevis* and *U. minor*, accompanied by *Acer campestre*, *Acer negundo*, *Populus alba*, *Carpinus betulus*, *Tilia platyphyllos*, *Malus sylvestris*. *Juglans nigra* and *Ailanthus officinalis* are present at Vladimirescu, near planted parcels with *Juglans nigra*. In the underwood, we found *Cornus sanguinea*, *Prunus spinosa*, *Sambucus nigra*, *Ligustrum vulgare*, *Crataegus monogyna*. Here and there (islands, chiefly) the forest have a luxuriant physiognomy due to abundance of *Vitis vinifera sylvestris*, *Humulus lupulus* and *Parthenocissus inserta*. The herbaceous layer coverage is variable, with typical forest species (*Brachypodium sylvaticum*, *Carex sylvatica*, *Corydalis cava*, *Geranium robertianum*, *Geum*

urbanum, *Lapsana communis*, *Polygonatum latifolium*, *Stachys sylvatica*, *Viola reichenbachiana* etc.), sometimes forming dense patches (*facies*).

In all locations, these forests are divided in rectangular parcels by back roads 2-4 m wide. It is an evidence of intensive wood exploitation (trees exceeding 70-80 years aged are very rare) and hunting. Back roads are also passage ways for ruderal and invasive plants.

Conservation value: medium.

92A0 *Salix alba* and *Populus alba* galleries (= R4407 Danubian forests of White Willow (*Salix alba*) with *Rubus caesius*)

The physiognomy of these communities ranges from dense alluvial forests with *Salix alba* and *Populus alba* (but also hybrid poplars) in variable proportions, to sparse tree patches. This type of forests (when *Salix alba* is the dominant species) occupy floodable areas. Sporadically, *Fraxinus angustifolia*, *Sambucus nigra*, *Acer negundo*, *Cornus sanguinea* and other woody species appear. The herbaceous layer is composed by species belonging roughly to two categories: nitrophilous (*Galium aparine*, *Rubus caesius*, *Urtica dioica* etc.) and hygrophilous (*Iris pseudacorus*, *Lythrum salicaria*, *Lycopus europaeus*, *Ranunculus sceleratus*, *Carex riparia* etc.)

Conservation value: high.

1530 * Pannonic salt steppes and salt marshes (= R1529 *Hordeum hystrix* ponto-pannonic meadows)

This alkali meadow type was identified at Felnac and Igrış, on small areas. The floristic diversity is low, only few characteristic species being present: *Hordeum hystrix*, *Bromus hordeaceus*, *Poa angustifolia*, *Chamomilla recutita*, *Verbena officinalis*, *Achillea setacea*, *Scorzonera cana*, *Trifolium fragiferum*, *Rorippa kernerii*, *Aster tripolium*. The origin of these meadows is probably secondary, as indicates Toth *et al.* (2009) for similar ecosystems in the Tisza valley.

Conservation value: medium

40A0 * Subcontinental peri-Pannonic scrub (= R3122 Ponto-Pannonic scrubs with *Prunus spinosa* and *Crataegus monogyna*; *Pruno spinosae* – *Crataegetum* Hueck 1931)

Prunus spinosa is a relatively frequent species in the four studied areas. It can be found on forests borders, in neglected canals, on meadows edges. Many of the patches we analyzed are poor in species presented in *EUR 27 Manual* as characteristic to this habitat. However, close to the typical floristic structure are the terraces from Felnac, where we found a small *Adonis vernalis* population. Other species are: *Rubus caesius*, *Urtica dioica*, *Brachypodium pinnatum*, *Rhamnus cathartica*, *Scabiosa ochroleuca*, *Carex hirta*, *Dacylis glomerata*, *Rosa canina*, *Pyrus pyraster*, *Agrimonia eupatoria*. A serious threat to these

communities is the expansion of *Amorpha fruticosa* which literally replace *Prunus spinosa* in forest borders, especially in the proximity of the river.

Conservation value: medium.

3150 Natural eutrophic lakes with *Magnopotamition* or *Hydrocharition*-type vegetation (= R2202 Danubian communities with *Lemna minor*, *L. trisulca*, *Spirodela polyrhiza* and *Wolffia arrhiza*)

Free, shallow water pans, in canals and ponds, present a layer of duckweed. Other species identified are common with the habitats R5305 and 5309 (*Alisma plantago-aquatica*, *Butomus umbellatus*, *Typha latifolia*, *Sparganium erectum* etc.). Submerged species as *Potamogeton sp.* and *Ceratophyllum sp.* appear also associated with *Lemna minor*. There are difficulties in mapping such communities seeing their small areas.

Conservation value: medium.

R5305 Danubian communities with *Typha angustifolia* and *T. latifolia* (*Typhetum latifoliae* G. Lang 1973)

Typha species indicate a certain degree of eutrophication. We found these communities in canals with low water level (below 0,5 m) and on borders of former ballast pits ("cubice", rom. pl.). Generally, *Typha latifolia* is more frequent than *Typha angustifolia*. Other species found: *Butomus umbellatus*, *Sparganium erectum*, *Alisma plantago-aquatica*, *Glyceria maxima*, *Lycopus europaeus*. Unoccupied water surface is almost in all cases covered with *Lemna minor* layer. Traditionally, bulrush was used as insulating material in barrels manufacturing and for netting various domestic objects.

Conservation value: low.

R5309 Danubian communities with *Phragmites australis* and *Schoenoplectus lacustris* (*Scirpo – Phragmitetum* W. Koch 1926)

Reed communities were identified on canals and ponds, sometimes in patches inside other hydrophyllic communities. The vegetal carpet is dominated by *Phragmites australis*, a small coverage being realized by: *Calystegia sepium*, *Lycopus europaeus*, *Salix cinerea*, *Lysimachia vulgaris*, *Mentha aquatica*, *Solanum dulcamara* etc. Reed was a traditional roofing material; the present-day importance of reed beds is that of nesting place for many bird species.

Conservation value: medium.

R5310 Dacian- Danubian communities with cu *Carex elata*, *C. rostrata*, *C. riparia* și *C. acutiformis* (*Caricetum acutiformis* Engler 1933; *Caricetum ripariae* Knapp et Stoffer 1962)

Carex beds are dense vegetation found on canal banks and pond borders. They are dominated in the area by *Carex riparia*, accompanied by hygrophilous

species as: *Lycopus europaeus*, *Carex acutiformis*, *Lysimachia vulgaris*, *Calystegia sepium*, *Galium palustre*, *Eleocharis palustris*, *Iris pseudacorus*, *Symphytum officinale* etc. These communities harbour many invertebrate species.

Conservation value: medium.

6440 Alluvial meadows of river valleys of the *Cnidion dubii* (= R3716 Danubian-Pontic meadows of *Poa pratensis*, *Festuca pratensis* and *Alopecurus pratensis*)

We included in this habitat plant associations primarily found on the dyke acclivities. Dykes can be considered a refuge for mown meadows species, which otherwise are rare in the area. The floristic diversity is high and our 4 m² samples belong to various associations: *Salvio – Festucetum rupicolae* Zolyomi 1939, *Agrostideto – Festucetum pratensis* Soó 1949, *Poetum pratensis* Räv., Căzac. et Turenschi 1956, *Arrhenatheretum elatioris* (Br.-Bl. 1919) Scherer 1925. Among the most frequent and abundant species are: *Festuca rupicola*, *Dactylis glomerata*, *Alopecurus pratensis*, *Festuca pratensis*, *Vicia sativa*, *Medicago sativa*, *Salvia nemorosa*, *Astragalus glycyphyllus*. Normally, these meadows are mown (as dyke maintenance measure) by the Hidrological Administration, at least once a year. They are also used as pastures, especially in early spring. Portions of dykes invaded by communities from *Sambucetum ebuli* (Kaiser 1926) Felföldy 1942 and *Glycyrrhizetum echinatae* (Timár 1947) Slavnic 1951 demonstrate that the dyke clearance is not a unitary treatment. At Păuliș site, we even noticed the expansion of scrubs on the dyke. Because these meadows are important for invertebrate fauna, as well for their specific diversity, we recommend the mowing once a year in early summer.

Conservation value: medium.

Other anthropic (ruderal) habitats identified in the areas are:

- R8702 Anthropic communities, with *Onopordum acanthium*, *Carduus nutans* and *Centaurea calcitrapa*;
- R 8703 Anthropic communities with *Elymus repens*, *Arctium lappa*, *Artemisia annua* and *Ballota nigra*;
- R8704 Antropic communities, with *Polygonum aviculare*, *Lolium perenne*, *Sclerochloa dura* and *Plantago major* (*Lolio – Plantaginetum majoris* (Linkola 1921) Berger 1950), especially on the top of dyke and along many roads.

Roads and crop borders present an intricate complex of other associations from *Chenopodietea*, *Artemisietea*, *Bidentetia tripartiti* and *Plantaginetea majoris*. On the gravel river banks or abandoned ballast pits proximities we found small surfaces from *Filagini – Vulpietum* Oberd. 1938.

Discussion

The floristic list is composed by more than 350 cormophyte species, for the total studied area ($9 \text{ km}^2 \times 4 \text{ sites} = 36 \text{ km}^2$). Before interpreting this specific diversity as high, we must notice that a large part of species are weeds in cultivated crop edges, canals and other ruderal habitats. No species from Habitats Directive (92/43/EEC) were found. On the dyke, in Igriş, we did not identify two steppe species (*Dasypyrum villosum* (L.) P. Candargy and *Aegilops cylindrica* Host) mentioned by Coste *et al.* (1998) at Cenad, few kilometers downstream.

In this list, 20 species are invasives. From far, the most problematic case is *Amorpha fruticosa*. Doniță *et al.* (2005) consider the *Amorpha*-dominant communities as a habitat type (R4423 *Amorpha fruticosa scrub*), and they approximate the area covered with (in Romania) at "... > 50 ha, in 200-400 m² patches". We found this kind of phytocoenoses on much more large areas, in all four locations. Romanian authors established a correspondent plant association (*Amorphaetum fruticosae* (Borza 1954) Coste 1975, in Sanda *et al.*, 2008) or sub-associations (*Salicetum triandrae* Malcuit 1929 subas. *amorphosum fruticosae* Borza 1954; *Salicetum albae – fragilis* Issler 1926 em. Soó 1957 subas. *amorphosum fruticosae* Morariu et Danciu 1970, in Pop, 1978, Drăgulescu, 1995). We found a total area of *Amorpha* scrubs about 2411 ha (1544 ha – Păuliș, 131 ha – Vladimirescu, 391 ha – Felnac, 345 ha - Igriş), wich represents less than 10 % of the total studied area. Our observations convey to a trivalent behaviour of this species in starting the colonization: on neglected meadows (Colour plate Figure 11.), on river nude banks (as pioneer), and on forest clearances. It seems that floods are a key factor in spreading seeds (fruits). There is not a strategy to eliminate this non-native plants, except some isolate measures taken by land-owners (land clearing, burning - Păuliș). Accordingly, the spreading of *Amorpha fruticosa* is a severe threat to biodiversity, especialy by competing *Prunus spinosa* and *Crataegus monogyna* scrubs. The use of *Amorpha* fruits as medicine (Nistor *et al.*, 1987) is no more up-to-date.

The second invasive species as importance (in superficies) is *Ambrosia artemisiifolia*, found along roads, canals and in fallows. The presence of this species is a public health problem (due to its allergenic pollen) in all western part of Romania (Faur & Ianovici, 2001 and Hodișan & Morar, 2007 in Pele *et al.*, 2006).

Echinocystis lobata was found covering reed beds and scrub vegetation, in some cases copiously. This annual plant reduces the abundance of other native species by shading; its seeds are eaten by birds (Anastasiu & Negrean, 2007). As in case of *Amorpha fruticosa*, proliferation of this species has a high potential in altering the landscape. Drăgulescu (1995) includes this community type in the association *Salicetum albae – fragilis* Issler 1926 em. Soó 1957 as a new facies (*echinocystosum*).

Parthenocissus inserta is less worrisome, except its presence within the Islands of Igriş natural reserve, where it competes native lianas (*Clematis vitalba*). In such areas, rootage of *Parthenocissus* populations should be scheduled, as part of ecological reconstruction plans.

An invasive in progress seems to be *Ailanthus glandulosus*, since Ardelean (1995) did not mention this species in Vladimirescu, where we found numerous individuals.

Erigeron annuus is frequent in all locations, and it forms dominant populations in fallows, in first years following cultivation abandon. Given the wide-spreading of this neophyte (Sîrbu *et al.*, 2006) and its populations decrease by natural succession, a minimal control action recommended is mowing before seeds maturation.

Land-use categories

In all four study sites, we consider important for conservation purposes the ratio between (semi)natural ecosystems and the natural ecosystems. We included in the first category: *Amorpha fruticosa* scrubs, meadows, forests, other type of scrubs, water surfaces, gravel, reed, and in the second one: fallow, arable, villages and farm buildings, orchards and vineyards, pit ballasts and golf course. The ratio of (semi)natural ecosystems/anthropic ecosystems ranges from 1:0.42 (Vladimirescu) to 1:1.91 (Felnac); values for Păuliş and Igriş are 1:1.69 and respectively 1:0.96. This indicator is however arguable since the positioning of quadrats are arbitrarily chosen, and do not take into account the connectivity (a parameter which is calculated / estimated for larger areas).

Our maps (Colour plate Figures 7-10) illustrate different situations, with arable fields and meadows in-between dykes, chiefly at Felnac and Igriş (areas included in the Lunca Mureşului Natural Park); it is obvious therefore the Administration of the Park has to set specific management measures and work closely to locals.

Another tendency we notice is the land recuperation by some land-owners who build farms and huts near water (at Păuliş and Vladimirescu, especially).

We can interpret this as a returning to traditional farming systems, with temporary buildings near fields ("sălaşe", rom. pl.), but also as a replacement of the sense of place by an exaggerated sense of property, since pastures are overgrazed and other symptoms of non-observance of nature management rules are obvious.

The cormophyte flora of studied locations comprises 370 species. The main invasive species is *Amorpha fruticosa*, and control actions should be urgently initiated.

As definitive (semi)natural ecosystems, the main ones are: the *Quercus robur* – *Fraxinus* forest, riverine willows plus poplars forests and meadows on dykes acclivities. Permanent wet meadows are invaded by scrubs or over-grazed. Fens occupy small areas in sampled areas. The naturalness of analyzed (semi)natural

vegetation samples was the most frequently expressed by values of 3 and 4 on Németh & Seregélyes scale (Takács & Molnár, 2009).

Agriculture in the area is based mainly on some crops (maize, wheat, barley, sunflower). Orchards and meadows show a neglected aspect (Colour plate Figure 12) and reflect recent mutations in Romanian agriculture, as well as a shift from traditional uses (Colour plate Figure 13).

Among the ecosystem services provided by the habitats we identified, to be used as main direction in public information, and to keep local communities aware of, we may list as priorities (categories according to WRI, Millenium Ecosystem Assessment, 2005):

- a) Provisioning services: food, fuel, wood, medicinal plants, ornamental plants;
- b) Cultural services: recreational, ecotourism, education, sense of place;
- c) Supporting services: habitat for game, water and nutrients recycling;
- d) Regulating services: local climate regulation, pollination of crops, water clearance, protection against floods.

Conclusions

From the six strategic axes proposed by Austad (2000) for agriculture in preserving cultural landscape values, two are applicable to the cases we studied: protection of semi-natural vegetation types, and encouraging low-intensity farming, especially within the Lunca Mureşului Natural Park. Intensification of agriculture and landscape simplification, a probable trend since the landed property regime will be more stable, is generally correlated with a decrease in plant diversity (α - and β -diversity), as found by Flohre *et al.* (2011). More specific research is needed in re-connected local communities to their natural matrix, taking into account the ecosystem services, but also the community values (Raymond 2008).

References

- Anastasiu, P., Negrean, G., 2007: Invadatorii vegetali din România, Ed. Universităţii din Bucureşti, Bucureşti
- Anastasiu, P., Negrean, G., Başnou, C., Sîrbu, C., Oprea, A., 2008: A preliminary study on the neophytes of wetlands in Romania, *in*: Essl, W.F., Klingenstein, F. (eds.) 2008: Biological Invasions – from Ecology to Conservation, NEOBIOTA 7, pp. 180-190
- Ardelean, A., 1995: Studiu comparativ al florei şi vegetaţiei din pădurile de luncă de la Vladimirescu şi Ceala din jurul municipiului Arad, *Lucrări Ştiinţifice, Universitatea de Ştiinţe Agricole a Banatului, Facultatea de Agricultură*, XXVIII, vol. III, Timişoara, pp. 479-484
- Ardelean, A., 2006: Flora şi vegetaţia judeţului Arad, Ed. Academiei Române, Bucureşti

- Austad, I., 2000. The future of traditional agriculture landscapes: retaining desirable qualities. *in*: Klijn, J., Vos, W. (Eds.), *From Landscape Ecology to Landscape Science*. Kluwer Academic Publishers, WLO, Wageningen, 43–56.
- Billetter, R., Liira, J., Bailey, D., Butger, R., Arens, P., Augenstein, I., Aviron, S., Baudry, J., Bukacek, R., Burel, F., Cerny, M., De Blust, G., De Cock, R., Diekötter, T., Dietz, H., Dirksen, J., Dormann, C., Durka, W., Frenzel, M., Hamersky, R., Hendrickx, F., Herzog, F., Klotz, S., Koolstra, B., Lausch, A., Le Coeur, D., Maelfait, J.P., Opdam, P., Raubalova, M., Schermann, A., Schermann, N., Schmidt, T., Schweiger, O., Smulders, M.J.M., Speelmans, M., Simova, P., Verboom, J., van Windbergen, W.K.R.E., Zobel, M., Edwards, P.J., 2008: Indicators for biodiversity in agricultural landscapes: a pan-European study, *Journal of Applied Ecology*, 45, 141-150
- Borza, A., 1942: *Echinocystis lobata* (Michx.) Torr. et Gray și alte plante americane încetățenite în Banat, *Buletinul Grădinii Botanice și al Muzeului Botanic dela Universitatea din Cluj la Timișoara*, XXII, 1-4, pp. 178-180
- Ciocârlan, V., 2009: Flora ilustrată a României. *Pteridophyta et Spermatophyta*, Ed. Ceres, București.
- Coste, I., Boboiciov, S., Chelu, A., 1998: Contribuții la studiul vegetației ierboase mezoxerofile din rezervația naturală Cenad, *Lucrări științifice, USAB, XXX, seria II, Agricultură, Timișoara*, 375-382
- Doniță, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriș, I.-A., 2005: *Habitatele din România*, Ed. Tehnică-Silvică, București
- Doniță, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriș, I.-A., 2006: *Habitatele din România. Modificări conform amendamentelor propuse de România și Bulgaria la Directiva Habitate (92/43/EEC)*, Ed. Tehnică-Silvică, București
- Drăgulescu, C. 1995: The Maros / Mureș River Valley. A study of the geography, hydrobiology and ecology of the river and its environment. The flora and vegetation of the Mureș (Maros) Valley. *Tiscia monograph series, Szolnok-Szeged-Târgu Mureș*, 47-111
- Flohre, A., Fischer, C., Aavik, T., Bengtsson, J., Berendse, F., Bommarco, R., Cernygie, P., Clement, L.W., Dennis, C., Eggers, S., Emmerson, M., Geiger, F., Guerrero, I., Hawro, V., Inchausti, P., Liira, J., Morales, M.B., Onate, J.J., Pärt, T., Weisser, W.W., Winqvist, C., Thies, C., Tschardtke, T., 2011: Agricultural intensification and biodiversity partitioning in European landscapes comparing plants, carabids, and birds, *Ecological Applications*, 21(5), 172-181
- Gafta, D., Mountford, O. (coords), 2008: *Manual de interpretare a habitatelor NATURA 2000 din România*, Ed. Risoprint, Cluj-Napoca
- Ivan, D., Doniță, N., Coldea, G., Sanda, V., Popescu, A., Chifu, T., Boșcaiu, N., Mititelu, D., Paucă-Comănescu, M., 1993: *Végétation potentielle de la Roumanie*, *Braun-Blanquetia*, 9, Camerino, 3-79
- Nistor, C., Popescu, H., Tămaș, M., Polnicencu, C., Fabian, A., Nistor, V., Curte, M., Mihail, N., Onișor, M., 1987: *Contributions à la valorification des essences volatiles des plantes de la flore de Roumanie II. Certaines essences volatiles indigènes pour préparations aromatiques calmantes*, *Contribuții botanice, Cluj-Napoca*, 283-287
- Oprea, I.V., 1976: *Flora și vegetația din Câmpia Sănnicolaul Mare (jud. Timiș)*, Teză de doctorat, Universitatea "Babeș-Bolyai", Facultatea de Biologie, Geografie și Geologie, Cluj Napoca

- Paşcovschi, S., Doniţă, N., 1967: Vegetația lemnoasă din silvostepa României, Ed. Academiei Republicii Socialiste România, Bucureşti
- Pele, G., Ardelean, A., Turcuş, V., 2006: Invasive plants in the Arad county (South-West Romania), *Annals of West University of Timișoara, Ser. Biology*, IX, 81-90
- Pop, I. (coord.), 1978: Flora și vegetația Munților Zarand, *Contribuții botanice, Cluj-Napoca*, 3-26
- Pop, I., 1979: Considerații fitocenologice asupra Pădurii Ciala (jud. Arad), *Contribuții botanice, Cluj-Napoca*, 119-124
- Raymond, C.M., Bryan, B.A., Hatton MacDonald, D., Cast, A., Strathearn, S., Grangirard, A., Kalivas, T., 2008: Mapping community values for natural capital and ecosystem services, *Ecological economics*, 68, 1301-1315
- Rouquette, J.R., Posthumus, H., Gowing, D.J.G., Tucker, G., Dawson, Q.L., Hess, T.M., Morris, J., 2009 – Valuing nature-conservation interests on agricultural floodplains, *Journal of Applied Ecology*, 46, 289-296
- Sanda, V., Öllerer, K., Burescu, P., 2008: Fitocenozele din România. Sintaxonomie, structură, dinamică, *Ars Docendi, Universitatea din Bucureşti*
- Săvulescu, T. (red.), 1952-1976: Flora Republicii Populare Române / Flora Republicii Socialiste România, vol. I-XIII, Ed. Academiei Republicii Populare Române / Republicii Socialiste România, Bucureşti
- Schrött, L., Sinitean, A., 2000: Rare plant species which need to be safeguarded in the forest steppe in the west of Romania, *Lucrări Științifice - Agricultură, Universitatea de Științe Agricole și Medicină Veterinară a Banatului Timișoara, Vol. 32, No. 3, pp. 787-792*
- Sîrbu, C., Paraschiv, N.-L., Chelariu, E.-L., 2006: Invasion of *Erigeron annuus* (L.) Pers. in Romania: historical, chorological and phytocoenological and phytocoological aspects, *Proceedings of the 36th Anual Meeting of the European Society for New Methods in Agricultural Research (ESNA)*, 36: 847-854
- Takács, G., Molnár, Z. (eds.), 2009: National Biodiversity Monitoring System XI. Habitat mapping, 2nd modified edition, MTA Ökológiai és Botanikai Kutatóintézet, Vácrátót, Környezetvédelmi és Vizügyi Minisztérium, Budapest
- Toth, T., Langhor, R., Becze-Deák, J., Molnár, Z., 2009: Field pedological characterization of two transects along the inner and outer side of a sixty year Tisza dike – a contribution to the problem of primary and secondary alkali grasslands, *AGD Landscape and Environment*, 3 (2), 87-112
- *** European Commission, DG Environment, 2007: Interpretation Manual of European Union Habitats EUR 27, July 2007
- *** WRI, Millenium Ecosystem Assessment, 2005: Ecosystems and Human Well-being: Biodiversity Synthesis, World Resources Institute, Washington, DC, USA